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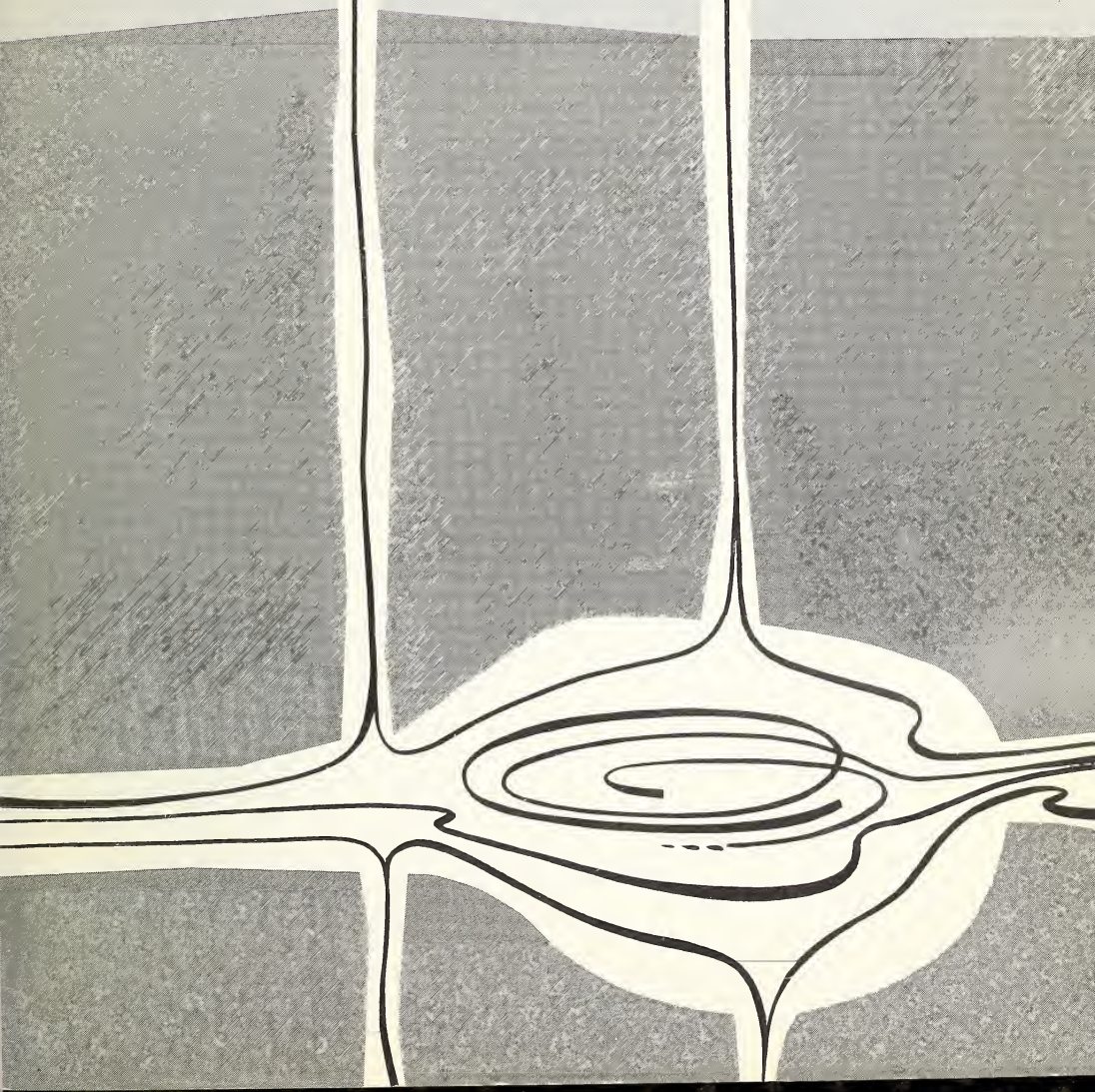
IRRIGATING DRY BEANS in the West



Irrigation permits farmers to grow beans on arid land that would otherwise be unproductive for row crops. On semiarid lands where bean production would otherwise be marginal, proper irrigation assures high yields.

Irrigation water can be applied to beans in graded or level furrows, in basins, or by sprinklers. Beans are sensitive to prolonged waterlogging of the soil. Therefore, care must be exercised to avoid ponding of water on the field for extended periods. Forming of adequate furrows during cultivation will keep most of the plants out of the water.

Consult your Soil Conservation Service or Extension Service specialists in developing your irrigation system, in preparing your field for irrigation, and in managing your water during irrigation.

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IRRIGATING DRY BEANS in the West

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Most areas producing dry, edible beans are irrigated in the arid and semiarid lands—the central Great Plains, the Pacific Northwest, and parts of California. Proper irrigation can contribute as much to high yields and quality as the selection of the right varieties or the application of adequate fertilizers.

If soil moisture is deficient, the foliage will change from light green to dark bluish green in most varieties of dry beans. During most of the season this color change is readily apparent and occurs rapidly, usually 1 to 3 days after the first spots begin to show. However, as the plants mature, this color change becomes difficult to detect. If moisture deficiency is prolonged, wilting and firing of the leaves will occur. If such severe wilting or firing is permitted, growth and yield may be seriously reduced.

Deficient soil moisture prior to blooming will delay crop development and extend the interval of pod formation. This delays harvest and reduces yield of harvestable beans due to shattering or loss of quality.

BN—13311

Moisture-deficiency symptoms in Great Northern beans at Scotts Bluff Experiment Station, Mitchell, Nebr. The dark strip through the crop is a six-row treatment from which irrigation has been withheld.

BN—13312

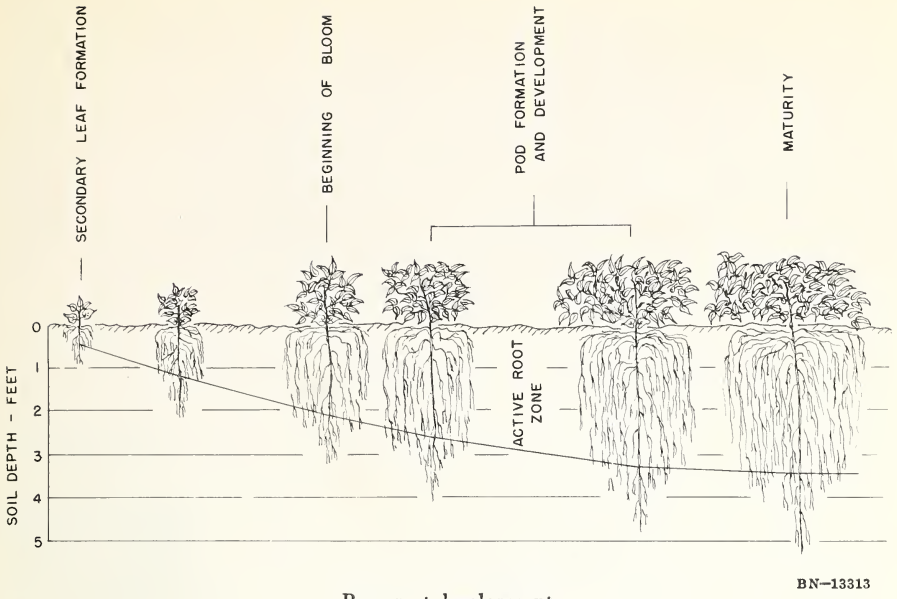
Moisture deficit in Great Northern beans at Scotts Bluff Experiment Station reduced vegetative and runner growth in rows at left.

Development of the Bean Plant and Its Moisture Requirements

To irrigate effectively when symptoms of soil-moisture deficiencies occur, growers will find a knowledge of bean root development helpful. When the seedlings emerge, roots are only 3 or 4 inches long. As the roots grow deeper and outward through the soil, the plants can use deeper stored moisture. In deep, well-drained soils, bean roots are well developed in the first foot of soil by the time the plants start to bloom; a few roots may extend beyond the 2-foot depth. By the time the pods start to ripen, roots have developed throughout the upper 3 feet of soil and some may extend into and extract some water from 4th and 5th foot depths.

The climate and length of growing season largely determine the amount of water needed to produce a bean crop. Beans in most areas will use 10 to 16 inches of water during the season, although as much as 20 and as low as 6 inches of water have produced successful crops. The proportion of soil moisture that must be supplied by irrigation is dependent on the amount and distribution of rainfall.

In addition to climate, the stage of crop development is important in how *fast* the crop uses water. The plants use about 0.06 to 0.08 inch of water per day during the first 2 or 3 weeks after emergence. During the blooming and pod-forming periods, the rate will be 0.2 to 0.3 inch per day. If the weather is hot and dry, this rate may continue un-



Bean root development.

til the first pods begin to ripen. As the weather becomes cooler and the plants mature, the crop will use water less rapidly.

The highest rate of water use usually coincides with the hottest weather—during July and early August. For short intervals the rate may be as high as 0.35 inch per day, especially for a few days after irrigation. It is necessary to design the irrigation system and schedule to meet these peak rates of water use.

Soil and Climatic Conditions That Affect Soil-Moisture Supply

Soil texture is largely determined by the amount of water that can be held in the soil and the availability of soil moisture to the plant. Fine-textured (clay) soils generally hold more plant-available water than coarse-textured (sandy) soils. As the soil dries, the rate of water movement from the soil mass to the root surface of plants slows down and this rate varies from one soil to another. Under similar conditions, clay soils will reach a limiting supply rate at a higher content of available moisture than sandy soils.

Root development of plants may be restricted by—

- Hardpans or plowpans;
- Poor aeration caused by saturation of the subsoil;
- Extremely heavy clay subsoils;
- Excessive accumulation of salts or toxic materials in the soil; or
- Such disease organisms as root rot.

Poor soil aeration, as that caused by water standing in low areas for 2 days or more, may kill beans. In early stages of growth, cultivating equipment that destroys part of the root system may restrict root growth.

Hot days with low humidity may cause moisture-deficiency symptoms in bean plants even when soil moisture is relatively high. Under these conditions, the soil fails to supply water as rapidly as the plants use it. If the bean plant is young and the roots are shallow, moisture deficiency may occur with abundant subsoil moisture. Similarly, if the soil is hard and the roots cannot penetrate or grow sufficiently to absorb the amount of moisture the plant needs, deficiency symptoms may occur with adequate deep moisture. As the roots grow deeper and thoroughly explore the soil, the plant can make use of the deep stored moisture.

Determining the Soil-Moisture Supply

As plant roots grow into the soil and remove water, the forces holding the remaining water in the soil become greater. Thus, it becomes increasingly difficult for plants to extract water as the soil dries. The bean plant will use only about two-thirds to three-fourths of the plant-available water from the surface foot of soil and about one-half from the other depths in which the roots are growing.

Various soils, when filled to capacity, will have the following approximate amount of water available to bean plants:

	Water available (in inches) at—	
	0 to 1 foot	*1 foot and deeper*
Sandy (coarse-textured) soils	0.5 to 0.9	0.4 to 0.7
Loamy (medium-textured) soils	.9 to 1.3	.7 to .9
Clay (fine-textured) soils	1.3 to 1.7	.9 to 1.1

These values take into account the differences in percentage of the available water extracted from different soils.

When To Irrigate

Irrigation water should be applied within 3 to 5 days after the bean foliage turns dark bluish green. Color will change in spots in the field; these areas give an advance indication of the condition over the whole field. If irrigation is delayed more than 7 to 10 days after the color changes in these spots, yields may be reduced. Such delay before blooming also delays crop development and harvest. After the crop has reached a growth stage wherein it is difficult to detect the color change, the table on page 5 will help you to determine if it is time to irrigate.

The quantities of water indicated in the table are general estimates designed as guides to the proper amount of irrigation water to apply when the foliage color change occurs. The times between irrigations indicated in the table are guides to the general frequency of irrigation necessary to maintain good growth.

The number of irrigations required during the growing season may vary from none, if enough

Guides in irrigating dry beans in the Western United States

Plant development		Water use rate	Moisture supply available to plants if soil is filled to capacity for [1]—			Time between irrigations [2]		
Stage of bean growth	Root zone depth		Sandy soils	Loams	Clays	Sandy soils	Loams	Clays
	Feet	*Inches per day*	*Inches*	*Inches*	*Inches*	*Days*	*Days*	*Days*
2 to 3 weeks after emergence	1. 0	0. 075	0. 5–0. 9	0. 9–1. 3	1. 3–1. 7	7–12	12–17	17–23
Early bloom	2. 0	.. 125	. 9–1. 6	1. 6–2. 2	2. 2–2. 8	7–13	13–18	18–23
Pod development	2. 5	. 25	1. 1–1. 9	1. 9–2. 6	2. 6–3. 3	4–8	8–10	10–13
Pod maturing	3. 0	. 20	1. 3–2. 3	2. 3–3. 1	3. 1–3. 9	6–11	11–15	15–20

[1] This value also denotes the amount of water needed to refill the root zone when plants change color. The range in values is due to soil variations within a textural grouping. *Sandy loams* hold less than *silt loams, sands* less than *loamy sands,* and *silty clays* less than *clays.* In irrigating, add 15 to 25 percent more water to take care of evaporation and deep percolation. That is, if 1.6 inches are needed for early-bloom stage of beans in a loam soil, apply 2 inches of irrigation water exclusive of runoff at the lower end of the field.

[2] The range in time between irrigations is due to climatic variations as well as variations in moisture supply for different soils within a textural grouping. In hot, dry, windy weather, irrigation is needed oftener than in cool, humid periods.

rainfall occurs at the right time, to six or more on sandy soils in arid areas. Cool, cloudy weather will extend intervals between irrigations.

Unless surface soil moisture is adequate for good seed germination, a preplanting irrigation should be applied. This irrigation will insure adequate subsoil moisture reserves for the crop to draw on. If irrigation water becomes scarce, the preplanting irrigation may lessen the drought hazard if the crop removes all the available water from the surface layer.

Do not overirrigate; allow the water to run in the furrow only as long as necessary to wet the soil in the root zone to field capacity. Footnote 1 of the table explains how to estimate the amount of water to add to different soils at various stages of plant development.

Apply the last irrigation early enough that the crop will extract most of the water from the soil layers at cutting time. A dry surface will make it easier to cut and thresh the beans and will prevent pods from rotting or the seed from becoming discolored.

Growth Through Agricultural Progress

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